UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Ex parte Xiangxin Bi, Ronald J. Mosso, Shivkumar Chiruvolu, Sujeet Kumar, James T. Gardner, Seung M. Lim, and William E. McGovern

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Appeal No. 2006-0289
Application No. 09/715,935

ON BRIEF

Before GARRIS, DELMENDO, and FRANKLIN, Administrative Patent Judges.

DELMENDO, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on an appeal under 35 U.S.C. § 134 (2004) from the examiner's final rejection of claims 18 through 54 and 56-61 (final Office action mailed on November 23, 2004), which appear to be (based on our review of the electronic record of the application) all of the claims pending in the above-identified application.

The subject matter on appeal relates to a method for coating a substrate (e.g., for eventual formation of optical devices or electrical devices). In particular, the invention is

said to relate "to highly uniform particle coatings on substrates and to efficient ways of forming highly uniform particle coatings that can be further processed to form glasses and other highly uniform coatings on a substrate." (Specification at 1, lines 9-16.) Further details of this appealed subject matter are recited in representative claims 18, 22, 27, 30, 31, 33, 34, 39, 42, 43, 45, 52, and 61 reproduced below:

> 18. A method of coating a substrate, the method comprising:
> reacting a reactant stream within a flow by directing a radiation beam at the reactant stream to produce within the flow a product stream comprising particles downstream from the radiation beam, wherein the particles are produced by the reaction, wherein the flow passes through the radiation beam, and wherein the reaction is driven by energy from the radiation beam;
> directing the flow of the product stream to a substrate; and
> moving the substrate relative to the flow of the product stream to coat the substrate.
>
> 22. The method of claim 18 wherein the reactant stream is elongated in a direction along the propagation of the radiation beam.
>
> 27. The method of claim 18 wherein the reactant inlet moves relative to the substrate such that motion of the reactant inlet sweeps the product particles across the substrate.
>
> 30. A method of forming a glass coating comprising heating a particle coating at a temperature and for a period of time sufficient to fuse the particles into a glass and where the particle coating is formed according to the method of claim 18.
>
> 31. A method of forming an optical component on a substrate surface, the method comprising removing a portion of a glass coating formed according to the method of claim 30 to form the optical component.
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> 33. A method of coating a substrate comprising:
> generating, within a flow, a reactant stream with a cross section

perpendicular to the propagation direction characterized by a major axis and a minor axis, the major axis being at least a factor of two greater than the minor axis;

reacting the reactant stream to form a product stream of particles within the flow; and

directing the flow of the product stream of particles to a substrate, wherein flow of the product stream is maintained other than by pumping on the substrate.

34. The method of claim 33 wherein at least about 25 grams per hour are deposited onto the substrate.

39. A method of coating a substrate having a diameter greater than about 5 cm, the method comprising:

reacting, within a flow, a reactant stream to form, within the flow, a product stream comprising product particles, wherein the particles are produced by the reaction; and

depositing simultaneously particles from the flow of the product stream over the entire surface of the substrate and wherein at least about 5 grams per hour of particles are deposited onto the substrate, wherein flow of the product stream is maintained other than by pumping on the substrate.

42. A method of coating a substrate comprising:

simultaneously generating multiple product streams each within a corresponding flow of a reactant stream by chemical reaction driven by a light beam; and

depositing the multiple product streams simultaneously on a moving substrate at sequential locations on the substrate.

43. The method of claim 18 wherein the reactant stream comprises a silicon precursor.

45. The method of claim 33 wherein the reactant stream comprises a silicon precursor.

52. The method of claim 39 wherein the reactant stream comprises a silicon precursor.

61. A method of coating a surface of a substrate, the method

comprising:

reacting, within a flow, a reactant stream to produce, within the flow, a product stream comprising particles wherein the particles are produced by the reaction;

directing the flow of the product stream to the substrate, wherein the substrate does not permit gas to pass through; and

moving the substrate relative to the flow of the product stream to deposit at least about 5 grams per hour onto the substrate surface.

The examiner relies on the following prior art references as evidence of unpatentability:

Carey, Jr.	4,011,067	Mar. 8, 1977
Rao et al. (Rao)	5,874,134	Feb. 23, 1999
Bi et al. (Bi)	5,958,348	Sep. 28, 1999
Borner et al. (Borner)	6,032,871	Mar. 7, 2000 (filed Jul. 15, 1998)
Tran et al. (Tran)	6,074,888	Jun. 13, 2000 (filed Aug. 18, 1998)
Lehman	6,097,144	Aug. 1, 2000 (filed Oct. 28, 1998)
Akedo et al. (Akedo)	6,280,802 B1	Aug. 28, 2001 (filed Jul. 26, 1999)
Kambe et al. (Kambe)(published PCT application)	WO 99/23189	May 14, 1999

The appealed claims stand rejected under 35 U.S.C. § 103(a) as follows:

A. claims 18 through 29, 33 through 42, 44, 46 through 51, 56, 57, and 59 through 61 as unpatentable over the combined teachings of Akedo, Bi, and Rao (examiner's answer mailed June 16, 2005 at 4-5);

B. claims 30, 43, 45, 52, and 58 as unpatentable over the combined teachings of Lehman, Akedo, Bi, Rao, and Kambe (id. at 5-7);

C. claims 18 through 29, 33 through 52, and 56 through 61 as unpatentable over the combined teachings of Akedo, Kambe, and Rao (id. at 7-8);

D. claim 30 as unpatentable over the combined teachings of Lehman, Akedo, Kambe, and Rao (id. at 8);

E. claims 31 and 32 as unpatentable over the combined teachings of Tran, Lehman, Akedo, Bi, Rao, and Kambe (id. at 9);

F. claims 31 and 32 as unpatentable over the combined teachings of Tran, Lehman, Akedo, Kambe, and Rao (id. at 9-10);

G. claims 18 through 29, 33 through 42, 47 through 51, 53, 54, 56, 57, and 59 through 61 as unpatentable over the combined teachings of Borner, Bi, and Rao (id. at 10-11);

H. claims 42 through 54 as unpatentable over the combined teachings of Borner, Akedo, Bi, and Rao (id. at 11-12); and

I. claims 18 through 22, 26 through 29, 33 through 42, 44, 46 through 51, 53, and 54 as unpatentable over the combined teachings of Bi and Carey (id. at 12).[1]

We affirm in part. Specifically, we affirm: rejection A as it applies to claims 18

[1] The examiner expressly withdrew the final rejection under 35 U.S.C. § 103(a) of claims 18-20, 23, 25, 27-29, 39-41, 56, and 58-61 over Rao in view of United States patent 5,744,777 issued to Bernecki et al. on Apr. 28, 1998. (Answer at 3.)

through 26, 28, 29, 33 through 41, 44, 46 through 51, 56, 57, and 59 through 61; rejection B in its entirety; rejection C as it applies to claims 18 through 26, 28, 29, 33 through 41, 43 through 52, and 56 through 61; rejections D through F in their entirety; rejection G as it applies to claims 18 through 26, 29, 33 through 42, 47 through 51, 53, 54, 56, 57, and 59 through 61; and rejection H in its entirety. However, we reverse: rejections A and C as they apply to claims 27 and 42; rejection G as it applies to claim 27; and rejection I in its entirety.[2]

Rejection A. Claims 18-29, 33-42, 44, 46-51, 56, 57, & 59-61: Akedo, Bi, & Rao

Claims 18-21, 23, 25, 28, 29, and 44

For rejection A, the appellants argue claims 18 through 21, 23, 25, 28, 29, and 44 as a group. We select claim 18 as representative of this group.

The examiner correctly finds (answer at 4-5) that Akedo describes a method of forming a film of particular ultrafine particles (e.g., metals or ceramics having a particle size in the range of 10 nm to 5 μm) on a substrate (i.e., coating a substrate) comprising the steps of spraying ultrafine particles onto a substrate and, before the ultrafine particles collide with the substrate, irradiating the ultrafine particles and substrate with an ionic, atomic, or molecular beam or low-temperature plasma or other high speed,

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[2] In their principal brief, the appellants provide reasonably specific arguments for the separate patentability of certain claims. Accordingly, we will discuss these arguments separately to the extent that the brief complies with 37 CFR § 41.37(c)(vii)(2005)(effective September 13, 2004).

high energy beam of energy atoms or molecules. (Column 2, line 41 to column 3, line 12; column 4, lines 39-50; Figure 1.) According to Akedo, the coating process involves moving the substrate relative to the ultrafine particle stream. (Column 2, line 61 to column 3, line 12; Figure 1, reference numeral 1.)

Thus, Akedo differs from the subject matter of appealed claim 18 in only one respect. Akedo does not teach that the particles are produced by passing a reactant stream within a flow of radiation beam, as recited in appealed claim 18. This difference notwithstanding, we share the examiner's determination (answer at 4-5) that one of ordinary skill in the art would have found the subject matter of appealed claim 18 as a whole obvious within the meaning of 35 U.S.C. § 103(a).

Bi[3] teaches an apparatus for making nanoparticles with average diameters of 100 nm or less, wherein gaseous reactant streams are activated by applying a radiation beam to form the nanoparticles. (Column 1, line 36 to column 2, line 24.) According to Bi, the apparatus "makes efficient use of resources at high production capacity without sacrificing quality of the resulting particles" and "is appropriate for the commercial production of particles..." (Column 2, lines 16-24.) Given the collective teachings of Akedo and Bi, we agree with the examiner that one of ordinary skill in the art would have been led to use the particles produced according to Bi's process in Akedo's

[3] Bi is identified in the present specification as disclosing an apparatus suitable for the appellants' claimed invention in the case where the particle production and coating operation are performed in separate chambers (specification at 31-38).

coating process with the reasonable expectation of obtaining the advantages (efficient use of resources at high production capacity without sacrificing quality) disclosed in Bi.[4]

The appellants argue that "the references do not teach that the steps [of Akedo] are burdensome in any way" and thus the "[e]xaminer is pointing to a solution without a problem to solve." (Appeal brief at 12.) The appellants' argument is unpersuasive because it appears to be based on an incorrect legal test for obviousness under 35 U.S.C. § 103(a). The pertinent "'question is whether there is something in the prior art as a whole to suggest the desirability, and thus the obviousness, of making the combination.'" In re Fulton, 391 F.3d 1995, 1200, 73 USPQ2d 1141, 1145 (Fed. Cir. 2004)(quoting In re Beattie, 974 F.2d 1309, 1311, 21 USPQ2d 1040, 1042 (Fed. Cir. 1992)).

As discussed above, Bi suggests that the particle production process described therein offers the desirability of efficient use of resources at high production capacity without sacrificing quality. We determine that this desirability is sufficient to support the examiner's conclusion that one of ordinary skill in the art would have been led to combine Akedo and Bi so as to arrive at the invention recited in appealed claim 18.

The appellants contend that "[t]he particles deposited directly from a reactive flow can form a coating with distinct properties that would not be expected to be

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[4] The examiner cites Rao as teaching "an in-line method." (Answer at 5.) Accordingly, with respect to appealed claim 18, Rao is cumulative to the combined teachings of Akedo and Bi.

reproduced from a two-step process." (Emphasis added; appeal brief at 12-13.) We note, however, that appealed claim 18 is broad enough to encompass both types of processes, and that the combination of Akedo and Bi suggests a process in which particle production and coating are performed in separate chambers.[5] This claim construction is consistent with the description found in the present specification, which informs one skilled in the relevant art that the particles may be produced in a chamber separate from the coating chamber. (Specification at 31, lines 11-13.) In re Bigio, 381 F.3d 1320, 1324, 72 USPQ2d 1209, 1211 (Fed. Cir. 2004)("[T]he PTO gives a disputed claim term its broadest reasonable interpretation during patent prosecution."); In re Morris, 127 F.3d 1048, 1054, 44 USPQ2d 1023, 1027 (Fed. Cir. 1997) ("[T]he PTO applies to the verbiage of the proposed claims the broadest reasonable meaning of the words in their ordinary usage as they would be understood by one of ordinary skill."); In re Zletz, 893 F.2d 319, 321-22, 13 USPQ2d 1320, 1322 (Fed. Cir. 1989)("During patent examination the pending claims must be interpreted as broadly as their terms reasonably allow.").

Furthermore, while the appellants' brief includes a conclusory statement that "[i]t has been shown that the claimed coating process can result in improved optical materials, as further described in copending U.S. Patent application serial number

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[5] In this regard, the appellants acknowledge: "Actually, the Bi patent teaches a continuous process. Similarly, the Akedo apparatus can be made continuous by putting in a continuous feed for the particle reservoir." (Appeal brief at 14.)

10/854,019," such a conclusory statement falls far short of demonstrating unexpected results commensurate in scope with the degree of patent protection desired. When, as here, a prima facie case of obviousness exists, the burden of proof is shifted to the applicants to show that the claimed invention would not have been obvious (e.g., by presenting objective evidence of unexpected results commensurate in scope with the claims). See, e.g., In re Mayne, 104 F.3d 1339, 1343, 41 USPQ2d 1451, 1455 (Fed. Cir. 1997).

The appellants argue that the combined teachings of the references do not result in an operable system because Bi teaches an operating pressure of 10 to 500 Torr (column 4, lines 65-67)[6] while Akedo "teaches a particular configuration with an aerosolizing chamber 21 leading to a nozzle to form an ultrafine particle stream" (column 6, lines 35-48). (Appeal brief at 15.) This argument is unpersuasive because the appellants fail to identify any acceptable reasoning on why the particles produced according to Bi's method, at atmospheric pressure or otherwise, cannot be used as a starting material in Akedo's aerosolizing chamber 21 prior to performing Akedo's coating process.

We have considered the appellants' arguments in the reply brief filed on August 16, 2005 but find them cumulative to those in the principal brief. The appellants

[6] Bi actually teaches: "Preferred chamber pressures range from very low vacuum pressures to about 1 atm, and more preferably from about 10 torr to about 500 torr."

acknowledge that laser pyrolysis as disclosed in Bi (as well as Kambe discussed below) was well known since the early 1980s. (Reply brief at 2.) Relying on various literature references (id.), the appellants urge that these prior art references "describe a fixed substrate and a batch process with a static atmosphere in which the coating condenses on the substrate rather than being directed toward the substrate." The appellants' argument, however, does not address the thrust of the examiner's rationale (answer at 15), which is that the nanoparticles produced according to Bi (and Kambe) may be used as the starting material in Akedo. We share the examiner's view that diverting the nanoparticles output of Bi (and Kambe) to facilitate the supply of Akedo's starting material(s) would have required nothing more than ordinary skill because Akedo teaches the necessary conditions. That is, after diverting the nanoparticles from the outputs of Bi (and Kambe), the state of the flow of nanoparticles can be routinely adjusted to match the expressly disclosed requirements of Akedo.

The appellants allege that the "extra manipulations of the particle [in Akedo] may or may not work with a reactive flow" and that the "[t]he particles in a reactive flow are not the same as an aerosol of preformed particles." (Reply brief at 5.) The appellants' allegation underscores the appellants' misunderstanding of the scope of the appealed claims, in particular claim 18. As pointed out above, appealed claim 18 reads on a method in which reaction and coating are performed in separate chambers, wherein the

process encompasses unrecited steps as well as the use of additional equipment to facilitate the combination of Bi and Akedo.

For these reasons, we uphold the examiner's rejection of claims 18 through 21, 23, 25, 28, 29, and 44 on this ground.

Claims 22, 24, 26, 33, 35-38, 46-49, & 57

For rejection A, the appellants argue claims 22, 24, 26, 33, 35 through 38, 46 through 49, and 57 as a group. We select claim 22 as representative of this group.[7]

The examiner finds that Bi expressly teaches that the reactant stream is elongated in a direction along the propagation of the radiation beam, as recited in appealed claim 22. (Answer at 15.) The appellants admit as much. (Appeal brief at 18.) Thus, the combination of Akedo and Bi would have necessarily resulted in a process in which the particles are produced using a reactant stream that is elongated in a direction along the propagation of the radiation beam.

The appellants urge that Akedo does not disclose a method for coating a substrate comprising reacting an elongated reactant stream and that Bi does not disclose a substrate coating process. (Appeal brief at 18.) The examiner, however, is relying on the collective teachings of the references to arrive at a conclusion of obviousness. In re Keller, 642 F.2d 413, 426, 208 USPQ 871, 882 (CCPA 1981)("[O]ne

[7] Claim 22 further limits claim 18 by reciting that the "reactant stream is elongated in a direction along the propagation of the radiation beam."

cannot show non-obviousness by attacking references individually where, as here, the rejections are based on combinations of references.").

The appellants argue that "an elongated reactant stream naturally turns into an elongated product stream." (Reply brief at 7.) This argument lacks merit because appealed claim 22 does not limit the shape of the "product stream" in the coating step.

For these reasons, we also uphold the examiner's rejection of claims 22, 24, 26, 33, 35 through 38, 46 through 49, and 57 on this ground.

Claim 27

Claim 27 further limits claim 18 by reciting that "the reactant inlet moves relative to the substrate such that motion of the reactant inlet sweeps the product particles across the substrate."

The examiner asserts: "Moving the substrate relative to the reactant stream (as taught by Akedo) and moving the reactant stream relative to the substrate are functional equivalents." (Answer at 15.) In counter argument, the appellants note that none of the applied references teach or suggest the feature specified in appealed claim 27.

We must agree with the appellants on this issue. The examiner does not identify any acceptable scientific reasoning or evidence establishing that "[m]oving the substrate relative to the reactant stream (as taught by Akedo) and moving the reactant stream relative to the substrate are functional equivalents." Absent proof, we cannot

affirm. In re Lee, 277 F.3d 1338, 1343, 61 USPQ2d 1430, 1433 (Fed. Cir. 2002) ("'The factual inquiry whether to combine references [or to modify a prior art teaching] must be thorough and searching.'...It must be based on objective evidence of record. This precedent has been reinforced in myriad decisions, and cannot be dispensed with.").

Claims 34, 39-41, 50, 51, 56, 60, & 61

For rejection A, the appellants argue claims 34, 39 through 41, 50, 51, 56, 60, and 61 as a group. We select claim 61 as representative of this group.

Independent claim 61 further defines the invention, relative to appealed claim 18, as follows: "moving the substrate relative to the flow of the product stream to deposit at least about 5 grams per hour onto the substrate surface."

Akedo teaches (column 3, lines 16-23):

> [I]n the deposit of ultrafine particle materials, the relative speed of the ultrafine particles in the direction perpendicular to the substrate should be in the range from 3 m/sec to 300 m/sec, as this is adequate for an impact pressure of the degree required for contact among the ultrafine particles and with the substrate. Thus, at this speed, dense deposition upon the substrate is possible with a high adhesion strength.

Furthermore, for a particular type of ultrafine particles, Akedo teaches that a film having a thickness of 100 to 500 μm could be obtained at a film formation speed of 5 to 20 μm/min. (Column 12, lines 16-18.)

These teachings in Akedo would have indicated to one of ordinary skill in the art that the film deposition rate is a result-effective variable in coating processes. Thus, it would have been obvious to a person having ordinary skill in the art to arrive at an

optimum or workable range of deposition rates, including the here claimed deposition rate, by nothing more than routine experimentation. In re Boesch, 617 F.2d 272, 276, 205 USPQ 215, 219 (CCPA 1980)("[D]iscovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art."); In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955)("[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.").

Accordingly, we affirm the examiner's rejection of claims 34, 39 through 41, 50, 51, 56, 60, and 61 on this ground as well.

Claim 42

> 42. A method of coating a substrate comprising:
> simultaneously generating multiple product streams each within a corresponding flow of a reactant stream by chemical reaction driven by a light beam; and
> depositing the multiple product streams simultaneously on a moving substrate at sequential locations on the substrate.

The examiner's position with respect to claim 42 is that "duplication of parts is not patentable" and that "[u]sing a second apparatus of Bi would double the particle production." (Answer at 15.) The appellants, on the other hand, point out that there is no evidence to support the examiner's position. (Appeal brief at 22.)

We agree with the appellants that there is no evidence to support the examiner's position. Moreover, the examiner's "duplication of parts" theory to "double the particle production" does not take into account the claim limitation "depositing the multiple

product streams simultaneously on a moving substrate at sequential locations on the substrate" (emphasis added).

Because the examiner's position is not based on objective evidence and fails to account for a crucial claim limitation, we cannot affirm.

Rejection B. Claims 30, 43, 45, 52, & 58 over Lehman, Akedo, Bi, Rao, & Kambe

Claims 30 and 43

For rejection B, the appellants argue claims 30 and 43 as a group. We select claim 43 as representative of this group.

Claim 43 further limits appealed claim 18 by reciting that the reactant stream comprises a silicon precursor.

Akedo teaches that in order for a film made according to the prior art to retain the crystal structure of the original ultrafine particle and improve its characteristics, it was necessary to reheat the material to a high temperature either during or after deposition but that this heat treatment posed certain problems. (Column 2, lines 9-29.) Akedo's method is said to overcome this problem in that it forms films of ultrafine particles whereby even if a stream of ultrafine particle collides with the substrate at low speed, a strong bond is achieved between the ultrafine particles and the substrate at a low temperature state, so that the crystal properties of the ultrafine particles are maintained and a thin film with superior density and excellent adhesion is formed. (Column 2, lines 30-38.)

Lehman teaches a method for making a cathode ray tube (CRT) envelope comprising an inner glass layer made of a suitable browning-resistant material, such as lead-free glass, and an outer glass layer made of a material with good X-ray absorbing properties, such as lead-containing glass. (Column 2, lines 7-13.) Lehman further states that the outer layer may be a continuous part of the CRT envelope with the inner layer comprising a lead-free glass coating deposited thereon. (Column 2, lines 16-18.) The lead-free glass composition is said to include oxides of SiO_2, B_2O_3, K_2O, and BaO. (Column 3, line 57 to column 4, line 18.) According to Lehman, the process of forming the lead-free glass composition comprises, inter alia, grinding the composition to a frit to reduce the particle size to preferably 200-325 mesh, mixing with solvent, depositing the composition on a substrate using any suitable deposition method (e.g., dipping or spraying), and melting the frit. (Column 5, line 48 to column 6, line 32.)

Kambe teaches that laser pyrolysis, which is the same technology described in Bi (column 1, line 36 column 2, line 27; column 2, lines 57-64), may be used to produce various nanoscale particles, including silicon dioxide and metal oxide. (Pages 5-9. Appropriate precursor compounds are said to include silicon compounds. (Page 7, lines 6-14.)

Neither Akedo nor Bi teaches the use of a reactant stream comprising silicon precursor as recited in appealed claim 43. Nevertheless, the appellants do not dispute the examiner's determination that Akedo suggests that the coating process described

therein can be applied to oxide particles in general and that Kambe establishes that materials including metal oxides and silica, which are used for producing glass, may be produced by laser pyrolysis (the same technique described in Bi). (Answer at 6-7; appeal brief at 24-26; Akedo at column 5, lines 1-8; Kambe at 5-9; Bi at column 2, lines 57-60.) Thus, we concur with the examiner that one of ordinary skill in the art would have found it prima facie obvious to modify Lehman's glass coating process to include the use of laser pyrolysis to form silicon dioxide nanoparticles as shown in Bi and Kambe as well as the use of Akedo's coating method with the reasonable expectation of obtaining the advantages described in Bi (improved properties of nanoparticles and efficient use of resources at high production capacity without sacrifice in quality of the particles as disclosed in column 1, lines 10-25 and column 2, lines 16-24) and Akedo (formation of films of ultrafine particles whereby even if a stream of ultrafine particle collides with the substrate at low speed, a strong bond is achieved between the ultrafine particles and the substrate at a low temperature state, so that the crystal properties of the ultrafine particles are maintained and a thin film with superior density and excellent adhesion is formed as disclosed in column 2, lines 30-38).

The appellants' sole argument against the examiner's rejection of appealed claims 30 and 43 in the appeal brief (pages 25-26) is that Akedo teaches away from the claimed invention because Akedo is directed to crystalline materials whereas Lehman is directed to glass (an amorphous material). We cannot agree with the appellants.

Akedo states that the "crystal properties" of the particles are maintained. This statement does not indicate that the particles have a crystalline structure. To the contrary, the reference teaches that the surfaces of the ultrafine particles are made amorphous. (Column 2, lines 41-60.) Because Kambe teaches that amorphous particles are formed by laser pyrolysis under certain conditions (page 21, lines 27-32), the prior art references would not have taught away from the claimed invention.

Accordingly, we uphold the examiner's rejection of claims 30 and 43 on this ground.

Claim 45

For claim 45, the appellants rely on the same arguments made against rejection A with respect to claims 22, 24, 26, 33, 35 through 38, 46 through 49, and 57. (Appeal brief at 26.) However, we find these arguments unpersuasive for the same reasons discussed above.

Claims 52 and 58

For rejection B, the appellants group claims 52 and 58 together. The appellants rely on the same arguments against rejection A with respect to claims 34, 39 through 41, 50, 51, 56, 60, and 61. (Appeal brief at 26-27.) However, we find these arguments unpersuasive for the same reasons discussed above.

Rejection C. Claims 18-29, 33-52, & 56-61 over Akedo, Kambe, & Rao

For rejection C, the appellants acknowledge that "[t]he apparatus and methodology in the Kambe application are comparable to the corresponding apparatus and methodology in the Bi patent." (Appeal brief at 28.) In view of the similarities between Bi and Kambe, the appellants rely on the same arguments against the combination of Akedo, Bi, and Rao (i.e., rejection A).

Accordingly, for reasons that correspond to those set forth in our discussion of rejection A, we affirm the examiner's rejection of claims 18 through 26, 28, 29, 33 through 46, 48 through 52, and 56 through 61 but reverse the rejection of claims 27 and 42.

Rejection D. Claim 30 over Lehman, Akedo, Kambe, & Rao

The 35 U.S.C. § 103 rejection of claim 30 as unpatentable over Lehman, Akedo, Kambe, and Rao is cumulative to the rejection of the same claim as unpatentable over Lehman, Akedo, Bi, Rao, and Kambe as discussed above in rejection B.

With respect to this ground of rejection, the appellants urge that Lehman does not teach or suggest particle formation or particle deposition and that Lehman does not make up for the deficiencies in the combination of Akedo, Kambe, and Rao with respect to base claim 18. We note, however, that Kambe and Akedo teach particle formation and particle deposition, respectively. Again, the examiner's rejection is based on a

combination of references including Lehman, not Lehman alone. In re Keller, 642 F.2d at 426, 208 USPQ at 882.

For these reasons, we uphold the examiner's rejection on this ground.

Rejection E. Claims 31 & 32 over Tran, Lehman, Akedo, Bi, Rao, & Kambe

For rejection E, the appellants argue claims 31 and 32 together. Claim 31, which depends from claim 30, which in turn depends from claim 18, recites "removing a portion of a glass coating formed according to the method of claim 30 to form the optical component."

The examiner cites Tran to establish that it was known to produce optical components using photolithography. (Answer at 9.) Specifically, Tran teaches a method comprising the steps of: depositing an etch stop layer onto a semiconductor substrate; depositing an optical component layer onto the etch stop layer; coating the entire surface of the optical component layer with a photoresist material; applying a photoresist mask to the photoresist material on the optical component layer; selectively etching away the optical component layer to form at least one optical column; forming a pedestal for each of the optical columns by selectively etching away the etch stop layer; and finally polishing each of the optical columns, thereby forming monolithic optical components. (Column 1, lines 45-56.) Tran further teaches that once the optical component is formed, a crystal mixture of antireflectivity coating which contains magnesium fluoride, aluminum oxide, hafnium fluoride, silicon dioxide, and silicon

nitride is deposited over the entire surface of each optical component by electron beam evaporation, sputtering, chemical vapor deposition, or other similar process. (Column 5, lines 35-45.) The examiner's basic position is that it would have been obvious to one of ordinary skill in the art to use the coating method suggested by the collective teachings of Lehman, Akedo, Bi, Rao, and Kambe in Tran's fabrication method in order to obtain all of the advantages disclosed in each of these references, as discussed above. (Answer at 9.)

The appellants do not rely on any of the limitations recited in appealed claim 31 or 32. Instead, the appellants refer to the same arguments in support of their position that Akedo, Bi, and Rao do not render the subject matter of appealed claim 18, the base claim, prima facie obvious. (Appeal brief at 29-30.) However, we find these arguments unpersuasive for the same reasons discussed above in our discussion of rejection A.

Accordingly, we affirm this rejection as well.

Rejection F. Claims 31 & 32 over Tran, Lehman, Akedo, Kambe, & Rao

This rejection is identical to rejection E except the examiner no longer applies Bi, which is cumulative to the relied upon Kambe reference. Because the appellants rely on the same arguments made against rejection E, we affirm this rejection for the same reasons discussed above in rejection E.

Rejection G. Claims 18-29, 33-42, 47-51, 53, 54, 56, 57, & 59-61 over Borner, Bi, & Rao

Claims 18-21, 23, 25, 28, & 29

For rejection G, the appellants argue claims 18 through 21, 23, 25, 28, and 29 as a group. (Appeal brief at 31-35.) We select claim 18 as representative of this group.

Borner teaches an electrostatic coating method comprising electrically charging powder particles of a coating material with a different electrical charge and coating a workpiece (substrate) with the differently charged powder particles by means of at least two electrostatic application devices (e.g., corona spray gun). (Column 1, lines 26-34; Figures 1-3.) According to Borner, one of the differently charged particles may be mica (silicate). (Column 2, lines 56-65.)

The examiner acknowledges that Borner's method differs from the invention recited in appealed claim 18 in that the prior art does not disclose how the coating material is made. (Answer at 10.) Nevertheless, the examiner holds (id.):

> Bi teaches that nanoparticles exhibit exploitable chemical and mechanical properties that are different from larger sized particles, such as increased smoothness and thinner coatings (background). The apparatus taught by Bi is advantageous to use in order to produce these nanoparticles due to its efficient use of resources (column 2, lines 17-25). Therefore, it would have been obvious at the time the invention was made to a person having ordinary skill in the art to use the apparatus of Bi to produce the particle streams of Börner. By doing so, one [of ordinary skill in the art] would reap the benefits of having an efficient way of producing nano-sized particles such that a smoother and/or thinner coating is achieved.

We are in complete agreement with the examiner's findings of fact and conclusion of law. As we discussed previously, Bi provides the requisite motivation, suggestion, or teaching to produce nanoparticles, which would be inclusive of synthetic mica nanoparticles, using laser pyrolysis. When mica nanoparticles produced in accordance with Bi's method are used as a coating material in Borner, one of ordinary skill in the art would have reasonably expected to obtain all of the advantages suggested in Bi (column 1, lines 10-25; column 2, lines 16-24).

The appellants argue that Borner is nonanalogous art and therefore cannot be combined with Bi. (Appeal brief at 31.) We agree with the examiner's analysis (answer at 18).

The two separate tests for determining whether a prior art reference is analogous are as follows: (1) whether the art is from the same field of endeavor as that of the inventor, regardless of the problem addressed; and (2) if the reference is not within the inventor's endeavor, whether the reference is reasonably pertinent to the particular problem with which the inventor is involved. In re Bigio, 381 F.3d at 1325, 72 USPQ2d at 1211-12; In re Clay, 966 F.2d 656, 659, 23 USPQ2d 1058, 1060 (Fed. Cir. 1992).

In this case, Borner is analogous art because it satisfies the same field of endeavor test. Borner's disclosure relates to coating substrates with particles. Similarly, the appellants' specification states that the invention relates to "highly uniform

particle coatings on substrates."[8] Thus, Borner's teachings are in the same field of endeavor (coating substrates with particles) as the appellants' invention.

The appellants urge that one of ordinary skill in the art would not combine Borner with Bi because the former "relies on skill in the spray gun art" whereas the latter "discloses a complex apparatus for performing sophisticated production of highly uniform nanoparticles." (Appeal brief at 32.) This argument is unpersuasive. A person having ordinary skill in the art of coating would have known that some production process would have to be practiced to make the particles used in the coating method. Having such knowledge, no additional skill would have been necessary to determine that laser pyrolysis is one known method for producing such particles. Likewise, a person having ordinary skill in the art of nanoparticle production would have known that nanoparticles may be used for a variety of applications including coating processes.[9]

The appellants allege that "the particle flow from the Bi apparatus cannot be arbitrarily attached to other apparatuses without possibly adversely altering particle production." (Appeal brief at 34.) However, one of ordinary skill in the art would have avoided any problems by following the teachings of Bi. One of ordinary skill in the art

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[8] Contrary to the appellants' belief, the invention disclosed in the present specification is not limited to "precision coating art" (appeal brief at 32).

[9] Were we to accept the appellants' logic, the hairbrush in In re Bigio cited supra, would have been patentable simply because a person having ordinary skill in the art of hairbrushes, which may be made of polymers, is unfamiliar with polymer chemistry.

would have understood that the particles may be used as Borner's starting material after the particles are successfully produced.

Claims 22, 24, 26, 33, 35-38, 45-49, & 57

For rejection G, the appellants group claims 22, 24, 26, 33, 35 through 38, 45 through 49, and 57 together. We select claim 22, which depends from claim 18 and recites that "the reactant stream is elongated in a direction along the propagation of the radiation beam," as representative of this group.

The appellants' only argument is that Borner does not teach or suggest a particle stream elongated in one dimension. (Appeal brief at 35-36.) However, appealed claim 22 does not recite that the particle stream must be elongated. Rather, appealed claim 22 recites that "the reactant stream is elongated in a direction along the propagation of the radiation beam." Bi teaches this feature. (Column 1, lines 36-39.)

Accordingly, we uphold this ground of rejection as to these claims.

Claim 27

Claim 27 depends from claim 18 and recites that "the reactant inlet moves relative to the substrate such that motion of the reactant inlet sweeps the product particles across the substrate."

The examiner does not respond to the appellants' argument (appeal brief at 36) that the limitations of appealed claim 27 are not found in any of the applied prior art

references. For this reason, we reverse the examiner's rejection of this claim on this ground.

Claims 34, 39-41, 50-52, & 56

For rejection G, the appellants group claims 34, 39 through 41, 50 through 52, and 56 together. We select claim 34, which depends from claim 33 and recites "wherein at least about 25 grams per hour are deposited onto the substrate," as representative of this group.

The appellants argue that the applied prior art references do not expressly teach the recited coating rate. (Appeal brief at 37.) The appellants are correct. We note, however, that Borner teaches the importance of coating thickness. (Column 1, lines 6-18.) Because the coating process must be conducted within a reasonable period of time, the coating rate would necessarily be a result-effective variable. Hence, it would have been obvious to a person having ordinary skill in the art to arrive at an optimum or workable range of deposition rates, including the here claimed deposition rate, by nothing more than routine experimentation. In re Boesch, 617 F.2d at 276, 205 USPQ at 219; In re Aller, 220 F.2d at 456, 105 USPQ at 235.

Claims 42, 53, & 54

For rejection G, the appellants argue claims 42, 53, and 54 together as a group. We select claim 42, which recites "depositing the multiple product streams

simultaneously on a moving substrate at sequential locations on the substrate," as representative of this group.

The appellants argue that the applied prior art references do not teach depositing multiple product streams simultaneously at sequential locations on the substrate. (Appeal brief at 38.) We note, however, that Borner shows the simultaneous application of two separate streams, which are not exactly coincident. (Figure 1.) Appealed claim 42 reads on a deposition step using Borner's stream arrangement.

Rejection H. Claims 42-54 over Borner, Akedo, Bi, & Rao

For this ground of rejection, the appellants rely on the same arguments as those made against rejection A as well as on the argument that Borner is nonanalogous art. (Appeal brief at 39.) We find these arguments unpersuasive for reasons already discussed above. Accordingly, we affirm this rejection as well.

Rejection I. Claims 18-22, 26-29, 33-42, 44, 46-51, 53, & 54 over Bi & Carey

We cannot sustain this rejection.

Carey teaches room air filters. (Column 1, lines 19-22.) This reference (air filtration) is not in the same field of endeavor as the appellant's invention (coating processes). Nor is filtration of air reasonably pertinent to one of the problems with which the present invention is concerned. Thus, Carey cannot properly be characterized as analogous art. In re Clay, 966 F.2d at 659, 23 USPQ2d at 1060.

For these reasons, the examiner's rejection on this ground is reversed.

Summary

In sum, we affirm the examiner's rejections under 35 U.S.C. § 103(a) of: claims 18 through 26, 28, 29, 33 through 41, 44, 46 through 51, 56, 57, and 59 through 61 as unpatentable over the combined teachings of Akedo, Bi, and Rao; claims 30, 43, 45, 52, and 58 as unpatentable over the combined teachings of Lehman, Akedo, Bi, Rao, and Kambe; claims 18 through 26, 28, 29, 33 through 41, 43 through 52, and 56 through 61 as unpatentable over the combined teachings of Akedo, Kambe, and Rao; claim 30 as unpatentable over the combined teachings of Lehman, Akedo, Kambe, and Rao; claims 31 and 32 as unpatentable over the combined teachings of Tran, Lehman, Akedo, Bi, Rao, and Kambe; claims 31 and 32 as unpatentable over the combined teachings of Tran, Lehman, Akedo, Kambe, and Rao; claims 18 through 26, 28, 29, 33 through 42, 47 through 51, 53, 54, 56, 57, and 59 through 61 as unpatentable over the combined teachings of Borner, Bi, and Rao; and claims 42 through 54 as unpatentable over the combined teachings of Borner, Akedo, Bi, and Rao. We reverse, however, the examiner's rejections under 35 U.S.C. § 103(a) of: claims 27 and 42 as unpatentable over the combined teachings of Akedo, Bi, and Rao; claim 27 as unpatentable over the combined teachings of Borner, Bi, and Rao; and claims 18 through 22, 26 through 29, 33 through 42, 44, 46 through 51, 53, and 54 as unpatentable over the combined teachings of Bi and Carey.

The decision of the examiner is affirmed in part.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a)(1)(iv).

AFFIRMED IN PART

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Administrative Patent Judge)
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Romulo H. Delmendo) BOARD OF PATENT
Administrative Patent Judge)
) APPEALS AND
)
) INTERFERENCES
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